

WHAT IS CLAIMED IS:

1. A gas barrier film having polypropylene as a base film, which comprises;

5 tuning molecular chains having, as a main skeleton, an -O-Si-O- structure by enabling the oxygen (-O-) thereof to be bonded to carbon atoms of the surface of said polypropylene film; and

10 an  $\text{SiO}_x$  thin film formed on the surface of said polypropylene film where said tuning molecular chains are bonded, said  $\text{SiO}_x$  thin film being bonded to said tuning molecular chains interposed between said polypropylene film and said  $\text{SiO}_x$  thin film.

15 2. The gas barrier film according to claim 1, wherein a bond ratio of said tuning molecular chains to a surface of said polypropylene film is in the range of 0.05 to 0.20 as measured based on an atomic ratio between the total number of carbon atoms constituting the surface of the polypropylene film and the number of oxygen atoms, each partially bonded to a carbon atom (i.e.  $Q_O/Q_C$ ; wherein  $Q_C$  represents the total number of carbon atoms constituting the surface of the polypropylene film, and  $Q_O$  is the number of oxygen functional groups, each partially bonded to a carbon atom).

20 25 3. The gas barrier film according to claim 1, wherein said tuning molecular chains include an alkyl

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group which is attached to an intermediate or terminal portion of the main skeleton thereof.

4. A method of manufacturing a gas barrier film having polypropylene as a base film, said method comprising the steps of;

5       activating carbon atoms of a surface of said polypropylene film by subjecting said polypropylene film to a plasma treatment, the activated carbon atoms being subsequently exposed to air atmosphere to allow the activated carbon atoms to be bonded with oxygen, thereby introducing oxygen functional groups into the surface of said polypropylene film;

10      allowing a coupling reaction to take place between the oxygen functional group of said polypropylene film and a silane coupling agent, thereby bonding tuning molecular chains having, as a main skeleton, an -O-Si-O- structure, to carbon atoms of the surface of said polypropylene film through said oxygen functional group (-O-); and

15      allowing a plasma polymerization between Si and O in a plasma atmosphere containing an organic silane compound and oxygen, thereby forming an  $\text{SiO}_x$  thin film on the surface of said polypropylene film having said tuning molecular chains bonded therein.

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25      5. The method according to claim 4, wherein said plasma treatment is performed using an argon plasma.

6. The method according to claim 4, wherein

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5 said oxygen functional groups are introduced into  
carbon atoms of the polypropylene film in the form of  
C-O and/or C=O.

10 7. The method according to claim 4, wherein an  
introduction ratio of said oxygen functional groups to  
the polypropylene film is in the range of 0.05 to 0.20  
as measured based on an atomic ratio between the total  
number of carbon atoms constituting the surface of  
the polypropylene film and the number of oxygen atoms,  
each partially bonded to a carbon atom (i.e.  $Q_O/Q_C$ ;  
wherein  $Q_C$  represents the total number of carbon atoms  
constituting the surface of the polypropylene film, and  
 $Q_O$  is the number of oxygen functional groups, each  
partially bonded to a carbon atom).

15 8. The method according to claim 4, wherein said  
silane coupling agent is an organic silane compound  
represented by a general formula of:  $-(R^1O)_n-Si-R^2(4-n)$   
(wherein  $R^1$  and  $R^2$  individually represents alkyl group  
having 1 to 4 carbon atoms).

20 9. The method according to claim 8, wherein said  
coupling reaction is performed by a process wherein the  
polypropylene film having said oxygen functional group  
introduced therein is immersed in an alcohol solution  
of the silane coupling agent, and then, heated the film  
coated with the alcohol solution.

25 10. The method according to claim 9, wherein a  
concentration of said silane coupling agent in the

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alcohol solution thereof is in the range of 0.1 to 10% by weight.

11. The method according to claim 9, wherein said polypropylene film coated with the alcohol solution is  
5 heated at a temperature of 50 to 80°C.

12. The method according to claim 4, wherein said organic silane compound is represented by a general formula of:  $-(R^1O)_n-Si-R^2(4-n)$  (wherein  $R^1$  and  $R^2$  individually represents alkyl group having 1 to 4  
10 carbon atoms).

13. The method according to claim 4 or 12, wherein said organic silane compound and oxygen are employed by mixing them at a molar ratio of; organic silane compound:oxygen = 3:7 - 5:5.

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